Chapter 5 The Integumentary System Lecture Outline

Integument
Composition
1. Cutaneous membrane
   A. Epidermis
   B. Dermis
2. Accessory organs
   A. Hair
   B. Exocrine glands
   C. Nails
Functions
1. Protection
2. Excretion
3. Temperature
4. Vitamin D3
5. Storage
6. Sensory

Epidermis
Characteristics
1. Stratified squamous epithelium
2. Avascular
3. Keratinocytes
Types
1. Thick skin
2. Thin skin
Layers
1. Stratum basale
   Epidermal ridges
   Fingerprints
   Hemidesmosomes
   Cells
   a. Basal / Germinative cells
   b. Melanocytes
   c. Tactile discs / Merkel cells
2. Stratum spinosum
   Keratinocytes
   Desmosomes
   Epidermal dendritic cells / Langerhans cells
3. Stratum granulosum
   Keratin fibers
   Keratohyaline granules
   Lamellated granules
4. Stratum lucidum
   Thick skin only
5. Stratum corneum
   Keratinization = cornification
   Soft keratin + keratohyaline
   Glycolipids
Insensible perspiration
Callus
Blister
Skin color
1. Epidermal pigmentation
   A. Carotene
   Vitamin A

B. Melanin
   Melanocytes
   Melanosomes
   UV protection
   Tyrosine
   Freckles
   Squamous cell carcinoma
   Melanoma
2. Dermal circulation
   Hemoglobin
   Vasodilation = red
   Vasoconstriction = pale
   Cyanosis
Abnormalities
   Jaundice
   Addisons disease
   Adrenocorticotropic hormone
   Albinism
   Vitiligo
   Vitamin D3 production
   Cholesterol
   Vitamin D3
   Calcitriol
   Calcium absorption

Dermis
Contents:
   Connective tissue cells
   Accessory organs of epidermis
   Blood vessels
   Lymph vessels
   Nerves
   Pain & touch receptors
Organization:
1. Papillary layer
   Areolar CT
   Dermal papillae
2. Reticular layer
   Dense irregular CT
   Lines of cleavage
   Contusion
Sensory perception
1. Tactile discs / Merkel cells
2. Free nerve endings
3. Tactile corpuscles / Meissner’s corpuscles
4. Lamellated corpuscles / Pacinian corpuscles
Subcutaneous layer / Hypodermis
   Areolar & adipose CT
   Sub Q injection
Accessory structures
1. Hair
   Structure
   Hair follicle
   stratified squamous epithelium
   Internal root sheath
Hair:
- External root sheath
- Glassy membrane
- Basal lamina
- Hair bulb
- Hair papilla
- CT & vessels
- Hair matrix
- melanocytes & epithelial stem cells

Hair:
- Hair root
- Hair shaft
- Cuticle
- Cortex
  - hard keratin
- Medulla
  - soft keratin

Shape:
- Flat = kinky
- Oval = wavy
- Round = straight

Type:
1. Vellus hairs
   - no medulla
2. Terminal hairs

Color:
- Melanin
- Iron
- Gray

Growth:
1. Active phase
2. Regressive phase
   - Club hair
3. Resting phase

Alopecia:
- Male pattern baldness

Hair removal:
- Function:
  - UV protection
  - Cushion
  - Insulation
  - Protection
  - Sensory detection
  - Hair root plexus

Arrector pili muscle

2. Integumentary glands
   - Exocrine
     A. Sebaceous glands
        - Holocrine secretion
        - Sebum
          - (lipids, cholesterol, proteins, electrolytes)
        - Functions
          - lubricate
          - prevent dehydration
          - inhibit bacteria

Acne
B. Sudoriferous / Sweat glands

1. Merocrine / Eccrine sudoriferous glands
   - Merocrine secretion
   - Sensible perspiration
     - (water, electrolytes, nutrients, antibodies, antimicrobials, wastes)
   - Functions
     - cooling
     - excretion
     - protection:
       - prevent adherence
       - wash
       - Dermcidin

2. Apocrine sudoriferous glands
   - Merocrine secretion
     - (sensible perspiration + proteins, lipids)
   - body odor
   - Myoepithelial cells
   - Special glands
     a. Mammary glands
     - milk
     b. Ceruminous glands
     - cerumen

3. Nails
   - hard keratin
   - Nail root

Injury and repair
- Mesenchymal cells
- Germinative cells
1. Cut → bleed
   - Mast cells → histamine → inflammation
2. Clot → scab
   - Phagocytosis
   - Statum basale division & migration
   - Fibroblast & mesenchymal cell division
   - Fibroblasts → collagen
   - Endothelial cells → capillaries
   - Granulation tissue
3. Epidermal migration
4. Scab shed
   - Fibroblasts → collagen → scar
   - Mesenchymal cells → CT cells
   - Keloid

Burns
- First degree: epidermis
- Second degree: epidermis & superficial dermis
- Third degree: all cutaneous layers

Skin grafts

Aging
- ↓ stem cells & repair
- ↓ Epidermal dendritic cells & immune response
- ↓ Vitamin D3 and calcium absorption
- ↓ glandular activity
- ↓ circulation
- ↓ hair production
- ↓ elasticity
- ↓ sex characteristics
Epidermis = superficial integument / superficial cutaneous membrane

Stratified squamous epithelium
Avascular
Mostly keratinocytes: cells filled with soft keratin protein
Two types:
1. Thick skin - up to 0.5mm, 5 layers, no hair, palms and soles
2. Thin skin - 0.1mm or less, 4 layers, usually hairy, most of body

Layers:

Stratum basale - single layer, attached to basal lamina by hemidesmosomes, extends into dermis as epidermal ridges (dermis = dermal papillae), cells mostly basal/germinative cells (stem cells) that constantly divide, some melanocytes (melanin), some Tactile discs /Merkel cells in hairless skin (touch receptors)

Stratum spinosum - 8-10 layers keratinocytes attached by desmosomes, some cells can divide, some Epidermal dendritic cells /Langerhans cells present (immune response)

Stratum granulosum - 3-5 layers keratinocytes producing keratin fibers, keratohyaline granules, and lamellated granules, no cell division, nuclei and organelles begin to disintegrate

Stratum lucidum - thick skin only, flat packed keratin filled keratinocytes

Stratum corneum - 15-30 layers dead keratinocytes that have been keratinized (cornified): soft keratin fibers glued in parallel arrays by keratohyaline, extracellular space filled with glycolipids from lamellated granules (cornified = water and chemical resistant)

Transit from stratum basale to stratum corneum: 15-30 days
Duration at stratum corneum: 7-14 days
Complete turnover every 25-45 days
**Dermis** = deep integument / deep cutaneous membrane

Contains: all cells of CT proper, accessory organs of integument (hair follicles, sweat and sebaceous glands), blood vessels, lymphatic vessels, nerves, sensory receptors

Two layers:
1. Papillary layer: thin (20%), areolar connective tissue, comprise dermal papillae, functions to feed epidermis
2. Reticular layer: thick (80%), dense irregular connective tissue, elastic and collagen fibers, functions to provide strength and flexibility
Hair Follicle structure:

**Hair follicle** - tube of stratified squamous epithelium anchored in dermis; surrounds, supports and produces hair; two layers:
- **Internal root sheath** - contacts hair
- **External root sheath** - contacts glassy membrane

**Glassy membrane** - thick basal lamina between epithelial follicle and connective tissue dermis

**Hair bulb** - expanded base of follicle where cell division occurs; surrounds papilla and matrix

**Hair papilla** - connective tissue at base of bulb; contains capillaries and nerves; supports matrix

**Hair matrix** - dividing epithelial cells and melanocytes above papilla that form new hair

**Hair structure:**

**Hair root** - embedded in dermis; not yet fully formed; contains live cells

**Hair shaft** - pokes through epidermis; fully organized dead hair; three layers:
- **cuticle** - outermost; overlapping dead keratinized cells form shiny surface
- **cortex** - middle layer; dead cells contain hard keratin to provide stiffness
- **medulla** - core; dead cells contain soft keratin and air to provide flexibility
Integumentary Injury Repair

**STEP 1:**
- injury occurs → damage & bleeding
- mast cells trigger inflammatory response

**STEP 2:**
- blood clot forms and dries into a scab
- phagocytic cells (neutrophils & macrophages) remove debris
- stratum basale cells divide and migrate around wound
- fibroblasts and mesenchymal cells divide and migrate into dermal area of wound
- fibroblasts secrete collagen to fill gap
- endothelial cells repair and grow new capillaries
- granulation tissue is formed = blood clot + fibroblasts secreting collagen + capillaries

**STEP 3:**
- new epidermal cells migrate over granulation tissue
- epidermis reforms under the scab

**STEP 4:**
- when epidermis is complete scab is shed
- fibroblasts continue to secrete collagen forming a scar
- mesenchymal cells differentiate to replace CT cells
- hair follicles, glands, muscles, and nerves not usually regenerated: replaced with collagen